Note. These were taken from "The Princeton Review AP Physics C Prep 2021".

1 Momentum

- Linear momentum is given by the equation $\mathbf{p} = m\mathbf{v}$
- The **Law of Conservation of Linear Momentum** states that linear momentum is conserved when no external forces act on a system.

$$\text{total } \mathbf{p}_{\text{before collision}} = \text{total } \mathbf{p}_{\text{after collision}}$$

- Elastic collisions **do** conserve kinetic energy.
  - In general, every collision conserves energy but not necessarily kinetic energy.
- Inelastic collisions **do not** conserve kinetic energy.
- When objects stick together, the collision is known as **perfectly inelastic**.
- Anytime a problem that involves collision or separation is given, first consider whether the Law of Conservation of Linear Momentum can be used.

2 Impulse

- Impulse is given by the equation:

$$J = \overline{F}\Delta t$$

- The **Impulse-Momentum Theorem** states that the impulse on an object is equal to the change in momentum of the object.

$$J = \overline{F}\Delta t = \Delta p$$

3 Center of Mass

- Usually the motion of an object is describing the motion of the center of mass. When you use Newton's Second Law, the acceleration is the acceleration of the center of mass.
- For point masses, $r_{\text{cm}} = \dfrac{\sum mr}{\sum m}$, where r is used for the position of each mass.
- For distributed mass, the equation is:

$$r_{\text{cm}} = \int r dm$$

- The linear density, $\lambda dr = dm$, for dm and then integrate to solve for the center of mass.